A new *Scolesa* Michener, 1949 from southeastern Brazil (Lepidoptera: Saturniidae, Ceratocampinae)

Carlos G. C. Mielke, Rodolphe Rougerie and Thibaud Decaëns

Carlos G. C. Mielke, Caixa Postal 1206, 84.145-000 Carambeí, Paraná, Brazil; cmielke1@uol.com.br
Rodolphe Rougerie, EA 1293 ECODIV, UFR Science et Techniques, Université de Rouen, F-76821 Mont Saint Aignan, France; rrougeri@gmail.com
Thibaud Decaëns, EA 1293 ECODIV, UFR Science et Techniques, Université de Rouen, F-76821 Mont Saint Aignan, France; thibaud.decaens@univ-rouen.fr

Abstract: *Scolesa* ***jauffreti*** **sp. n.** is described from southeastern Brazil and compared to the most similar species *Scolesa totoma* (Schaus, 1900) from southern Brazil. The two species differ mainly by their size, the male forewing shape, the general coloration of the moths, the course of the forewing postmedian line, and some structure of the female genitalia. These differences are further supported by distribution data and the analysis of mtDNA barcodes. The later also reveals that *S. totoma* might comprise a cryptic species in southern Brazil, for which further study is needed. The male holotype of the new species is deposited in the collection Padre Jesus S. Moure in the Department of Zoology at the Federal University of Paraná, Curitiba, Paraná, Brazil.

Eine neue *Scolesa* Michener, 1949 aus Südostbrasilien (Lepidoptera: Saturniidae, Ceratocampinae)

Zusammenfassung: Die neue Art *Scolesa* ***jauffreti*** **sp. n.** wird aus Südostbrasilien beschrieben und mit der ähnlichen *Scolesa totoma* (Schaus, 1900) aus Südbrasilien verglichen. Die beiden Arten unterscheiden sich hauptsächlich in der Größe, der Vorderflügelform der Männchen, dem generellen Farbton, dem Verlauf der Vorderflügel-Postmedianbinde sowie einigen Strukturen speziell im weiblichen Genitalapparat. Diese Unterschiede werden bestätigt durch allopatrische Verbreitung und mtDNA-Barcode-Daten. Letztere zeigen auch, daß *S. totoma* möglicherweise noch eine weitere kryptische Art in Südbrasilien umfassen könnte, was aber noch weiter untersucht werden muß. Der männliche Holotypus der neuen Art befindet sich in der Sammlung von Padre Jesus S. Moure im Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brasilien.

Introduction

The Neotropical genus *Scolesa* Michener, 1949 currently includes six valid species (Lemaire 1988, 1996): *S. hypoxantha* (W. Rothschild, 1907), *S. violacea* (W. Rothschild, 1907), *S. leucantha* (Boisduval, 1872), *S. viettei* Travassos, 1959, *S. nebulosa* Lemaire, 1971, and *S. totoma* (Schaus, 1900). The first two are from Argentina and Paraguay (Racheli 1995), and from Peru, respectively, whereas the four others are restricted to Brazil.

In the present article, the description of a new species of *Scolesa* is proposed from the Mantiqueira mountains, a mountain chain ranging from São Paulo to Rio de Janeiro and Minas Gerais states in Southeastern Brazil. This mountain reaches altitudes up to 2800 m and is well separated from areas in Southern Brazil where the most similar species, *S. totoma,* occurs. Also, the region is known for its endemism in several groups of Lepidoptera, including Saturniidae species like *Almeidella almeidai* Oiticica, 1946, *Prohylesia rosalinda* Draudt, 1929, *Cerodiphia mielkei* Lemaire, 2002, and *Dirphia monticola* Zerny, 1923. We note that the new species described below had likely been overlooked or mixed by Lemaire (1988) within the *S. totoma* section in his Ceratocampinae revision.

The present article raises the number of species within the genus to 7, and the number of species known from Brazil to 5.

Material and methods

Specimen collecting and morphological study

The material examined was obtained by night collecting in several places in southern and southeastern Brazil and by visiting some collections to get additional data for comparison of morphological features and geographic ranges of the new species and *S. totoma*. Collecting sites are located in the phytogeographic unit of the Brazilian Atlantic Forest, at elevations ranging from 700 to 2100 m. Light trapping consisted in using mercury vapor lamps powered by a small portable generator. All material examined, collecting sites and visited museums are listed under each species section.

Genital parts (male and female) were dissected and observed after classical preparation using 10% KOH solution for clearing of internal tissues.

DNA barcoding analysis

DNA was extracted from dry legs removed from the most recently collected specimens. We sampled four specimens of the new species and eight specimens of *S. totoma* from different localities in the states of Santa Catarina and Rio Grande do Sul. In addition, two specimens of the latter were sampled from CDH and also included in the analyses. Tissue samples were processed at the Biodiversity Institute of Ontario (BIO), Guelph, Canada. DNA was extracted using a routine silica-based extraction protocol (Ivanova et al. 2006). The barcode region of the mitochondrial Cytochrome Oxydase I gene (COI; Hebert et al. 2003) was amplified with the primer set LepF1/LepR1 targeting a 658 bp fragment (Hebert et al. 2004).

Data, images, and sequences are publicly available in the public dataset SCOL2012 on BOLD (the Barcode of Life Data-systems, www.boldsystems.org; Ratnasingham & Hebert 2007). All sequences were also deposited in GenBank with accession numbers JX438177 to JX438190.

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Acronyms used

CDH	coll. Daniel Herbin, Garidech, France.
CGCM	coll. Carlos G. C. Mielke, Curitiba, Brazil.
CSNB	coll. Stefan Naumann, Berlin, Germany.
CTD	coll. Thibaud Decaëns, Rouen, France.
DZUP (DZ)	coll. Padre Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil.
IOC	Fundação Oswaldo Cruz, Rio de Janeiro, Brazil.
MZSP	coll. Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil.
SMFL	coll. Senckenberg-Museum, Lepidoptera collection, Frankfurt am Main, Germany.

Other abbreviations

BC	specimens with a mtDNA barcode analysis.
FW	forewing.
HT	holotype.
HW	hindwing.
PT	paratype.

Description

Scolesa jauffreti sp. n.

Figs. 1a, 1b, 2a, 2b, 5, 6, 7, 8, 9.

Holotype ♂: "Holotypus, *Scolesa jauffreti* C. Mielke, Rougerie & Decaëns det. 2012", "5. ii. 2004, Pedra do Baú, São Bento do Sapucaí, 1800 m, SP, Brasil. A. Pereira leg.", "DZ 8.706". Donated by the senior author and deposited in DZUP. Figs. 1a, 1b.

Paratypes (in total 59 ♂♂, 12 ♀♀): All **Brazil. — Minas Gerais:** 2 ♂♂, 1 ♀, Sapucaí-mirim, Cidade Azul, 1400 m, 7. xi. 1953, L. Travassos F., M. Kuhlmann, C. Gans & S. Medeiros leg. (MZSP 01.948, 01.949, 01.954). 2 ♂♂, Itamonte, Várzea Grande, 1810 m, 5.–10. iii. 2011, C. Mielke leg. (CGCM 24.168, 24.728). — **Rio de Janeiro:** 1 ♂, Petrópolis, Pq. São Vicente, 920 m, 26. x. 1965, Gagarin leg., ex coll. Gagarin (DZ 8.739). 1 ♂, Itatiaia, Agulhas Negras, km 8, 2000 m, 10. i. 1953, Travassos & Pearson leg. (IOC 19.186). 3 ♂♂, [Itatiaia], 6. ii. 1932, 3. iii. 1918, 30. viii. 1921, ex coll. Zikán (IOC 15.969, 29.177, 29.178). — **São Paulo:** 1 ♂, Campos do Jordão, 1750 m, 10. ii. 1944, ex coll. Richard Frey (DZ 8.754). 2 ♂♂, 1 ♀, Campos do Jordão, 4.–7. ix. 1937, Travassos & Oiticica leg. (IOC 14.469–14.471). 1 ♂, Campos do Jordão, Faz. da Guarda, 15. ii. 1942, ex coll. D'Almeida (DZ 8.747). 17 ♂♂, 2 ♀♀, Campos do Jordão, Lagoinha, 1500 m, 14. xi. 1953, 17. iii. 1953, Travassos, Travassos F. & Rabello leg. (MZSP 01.939, 01.040, 01.941, 01.942, 01.943, 01.944, 01.950; IOC 19.174–19.184). 1 ♂, Campos do Jordão, Faz. Guarda Pinheiro Seco, 1750 m, 18. iii. 1964, Rabello, P. Biase & L. Travassos F. leg. (MZSP 01.951). 1 ♂, Campos do Jordão, 1600 m, 16.–20. ii. 2001, C. Mielke leg. (CGCM 22.997, in SMFL). 1 ♂, 1 ♀, Campos do Jordão, 1600–1900 m, 20.–27. ii. 2001, V. O. Becker leg. (CGCM 13.536, in CDH; 11.769). 1 ♀, Campos do Jordão, 1600 m, 23.–27. i. 2001, V. O. Becker leg. (CGCM 12.242). 2 ♂♂, Campos do Jordão, Rancho Santo Antônio, 24.–28. ii. 2006, 15.–21. ii. 2007, T. Decaëns leg. (BC-Dec0457, BC-Dec1346, CTD). 10 ♂♂, 3 ♀♀, Campos do Jordão, Umuarama, 1800 m, 3.–15. ii. 1937, Gagarin leg., ex coll. Gagarin (DZ 8.659, 8.667, 8.675, 8.699, 8.707, 8.715, 8.723, 8.762, 8.763, 8.981; CGCM 9.597; IOC 15.970–15.971). 1 ♂, Campos do Jordão, Umuarama, 1700 m, 31. i. 1938, Travassos & Oiticica leg., ex coll. D'Almeida (DZ 8.738). 1 ♂, Campos do Jordão, Umuarama, ex coll. Gagarin (DZ 8.755). 2 ♂♂, Campos do Jordão, Umuarama, i. 1943, ex coll. D'Almeida (DZ 8.683, 8.691). 3 ♂♂, 1 ♀, Campos do Jordão, Toriba, 1800 m, 13.–15. xi. 1953, Travassos F. & Travassos leg. (MZSP 01.936, 01.938 [in copula], 01.953 [in copula], IOC 19.185). 1 ♂, 1 ♀, Campos do Jordão, Toriba, 1700 m, 18. xi. 1952, 17. i. 1953, D'Almeida & L. Travassos F. leg. (MZSP 01.945, 01.952). 2 ♂♂, Santo Antônio do Pinhal, Eugênio Lefévre, 1200 m, 13.–20. xi. 1952, D'Almeida, L. Travassos F. & P. Pereira leg. (MZSP 01.946, 01.947). 1 ♂, same place as HT, 17.–18. ii. 2001, C. Mielke leg. (CGCM 23.189, in CSNB). 1 ♂, same data as HT (CGCM 8.987). 1 ♂, 1 ♀, same place as HT, 16.–17. ii. 2007, T. Decaëns leg. (BC-Dec1347, BC-Dec1348, CTD). — **Paraná:** 1 ♂, Palmas, 1952, V. Stawiarski leg., ex coll. Gagarin (DZ 8.746); probably mislabelled.

Etymology. The name is dedicated to †Pierre Jauffret (Santo Antônio do Tauá, Pará, Brazil) for his significant contribution to the knowledge of neotropical Lepidoptera.

Description

♂ (Figs. 1a, 1b). Wingspan: 50–62 mm, FW length: 25–30 mm. Head: antenna (ca. 35 segments) straw-coloured; frons light pinkish-gray to dark gray; labial palpus dark brown. Thorax dorsally pinkish beige marked by a pair of longitudinal dark gray lines and ventrally pinkish dark gray; legs dark gray, foretibia bearing an epiphysis of two thirds of its length; abdomen dorsally dark gray and ventrally pinkish beige. FW elongated, outer margin convex, apex pronounced; dorsally sprinkled with dark dots, antemedian line poorly marked, postmedian line oblique and dark gray, slightly preapical; basal area barely distinct, median area brown to pinkish-brown, postmedian area light gray to light brown; stigma, when present, dark gray and slightly marked; ventrally dark pinkish basomedian area, then brownish-beige distally; postmedian line dark gray only marked distally. HW dorsally without ornamentation; basomedian area pinkish with a darker inner margin and an almost invisible postmedian line; submarginal band lighter; ventrally light pinkish beige, with posterior part of the basomedian area pinkish; postmedian line as in the FW. Veins well marked distally on both wings.

♂ **genitalia** (Figs. 5–7): uncus narrow and bifid apically, a lobed protuberance arising from the posterior edge of the tegumen (Figs. 5–6); median plate of gnathos sub-triangular and pointed; valves short and rounded, armed with well developed and symmetrical harpes, the left valve bearing a sickle-shaped process at its base; phallus (Fig. 7) with vesica divided into two lobes, each with one cornutus, one smaller or absent; bulbus ejaculatorius short; aedeagus short and broad.

♀ (Figs. 2a, 2b). Wingspan: 65–79 mm, FW length: 32–39 mm. Head: antenna (ca. 38 segments) straw-coloured; frons and labial palpus dark gray. Thorax dark beige marked as in the ♂; legs dark gray, foretibia bearing

Figs. 1–2: *Scolesa jauffreti* sp. n.; always **a** = dorsal side, **b** = ventral side. **Fig. 1:** HT ♂. **Fig. 2:** PT ♀. — **Figs. 3–4:** *Scolesa totoma*. **Fig. 3:** ♂. **Fig. 4:** ♀. — Scales in mm; specimens and dorsal/ventral views not exactly to the same size. — **Fig. 10:** Geographical distribution of *Scolesa jauffreti* sp. n. and *S. totoma* in Brazil. **Fig. 10a:** overview, **Fig. 10b:** insertion (enlarged), details with populations differentiated.

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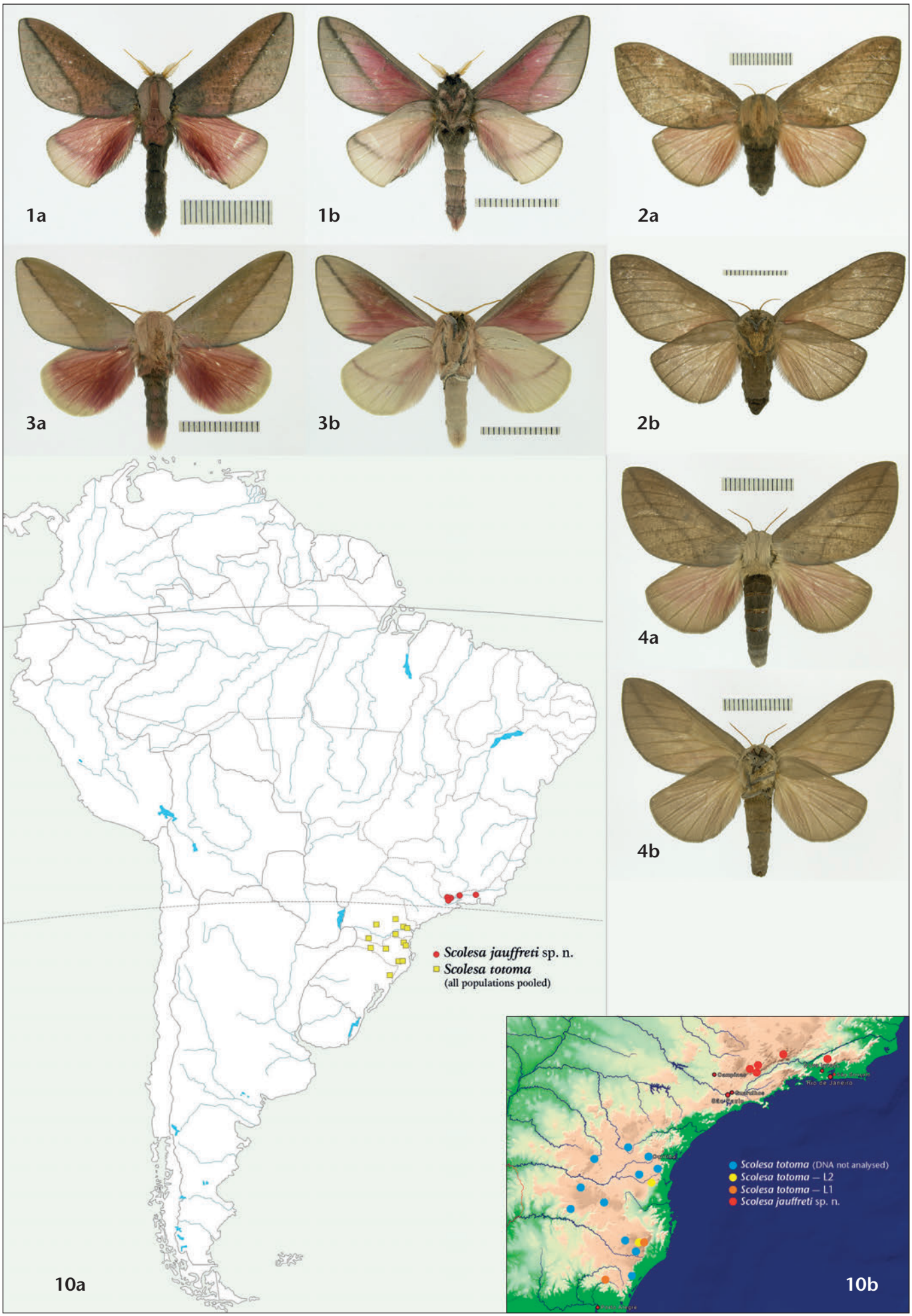

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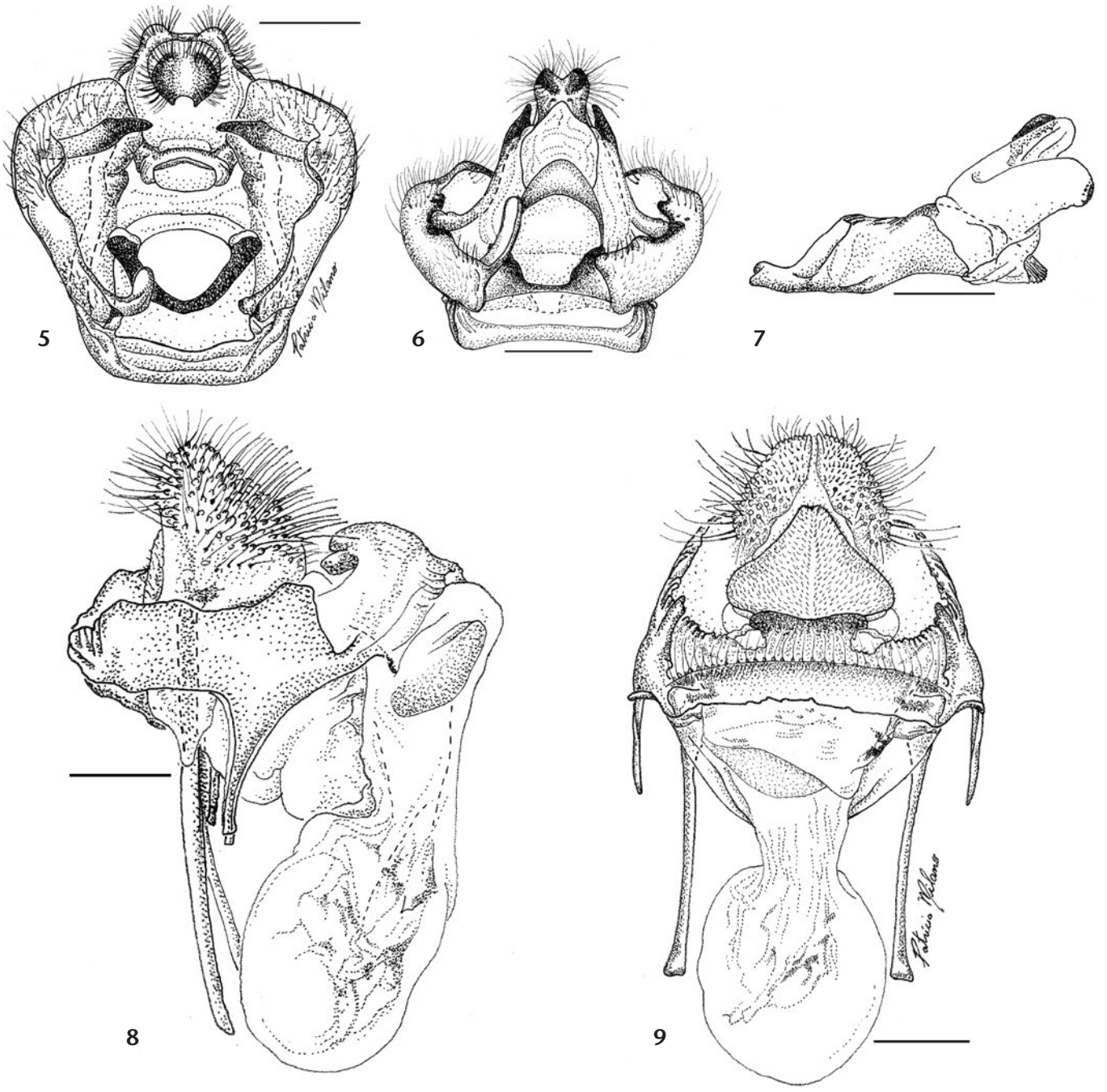

Figs. 5–9: *Scolesa jauffreti* sp. n. **Figs. 5–7:** ♂ genitalia (HT): ventral view (**5**), posterior view (**6**), phallus lateral view (**7**). **Figs. 8–9:** ♀ genitalia (PT): ventral view (**8**), lateral view (**9**). — Scale bars: 1 mm, approximately same size.

an epiphysis of three quarters of its length; abdomen dorsally dark gray, ventrally lighter. FW elongated, apex marked, outer margin convex; dorsal ground coloration brown, postmedian line oblique and dark brown, slightly preapical; discal spot, when present, dark gray; ventrally light brown, suffused with dark gray; postmedian line slightly marked, inner marginal area pinkish. HW without dorsal ornamentation; basomedian area pinkish, inner margin darker; ventrally marked as the forewing. Veins well marked distally on both wings.

♀ genitalia (Figs. 8, 9): lamella antevaginalis simple and fused with the 8th sternum; lamella postvaginalis presenting a transverse band with a lip-shaped posterior plate; ductus bursae with a ventral sclerotized (or partially sclerotized) plate opposite to the insertion of the ductus seminalis. Bursa copulatrix pear- or balloon-shaped, with a small signum. A second very small signum can be observed as a variation.

Immature stages: unknown.

Ethology. Males and females are attracted by light; ♀♀ are active at the beginning of the night only while ♂♂ were observed during the whole night.

Geographical distribution. *S. jauffreti* sp. n. is only known from southeastern Brazil, states of Minas Gerais, Rio de Janeiro, and São Paulo (Fig. 10) at altitudes ranging from 1200 to 1800 m. One ♂ from Palmas, Paraná state (ex coll. Gagarin), is probably mislabelled.

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Comparison with *Scolesa totoma*

Scolesa totoma (Schaus, 1900)

Figs. 3a, 3b, 4a, 4b.

Description: see Draudt (1930) and Lemaire (1988).

Examined material (in total 49 ♂♂, 27 ♀♀): All **Brazil. — São Paulo:** 2 ♂♂, Campos do Jordão, Umuarama, 8.–15.III.1937, Gagarin leg., ex coll. Gagarin (DZ); probably mislabelled. — **Paraná:** 11 ♂♂, 5 ♀♀, Curitiba, 920 m, 20. iii. 1970, 13. ix. 1974, 19. x. 1974, 5. xi. 1974, 20. xi. 1974, 26. xi. 1974, 15. xii. 1974, 15. iii. 1975, 10. iii. 1975, 15. iii. 1975, 5. v. 1975, 23. ix. 1975, 2. i. 1976, V. O. Becker leg. (CGCM 11.552, 11.741, 11.817, 11.830, 11.837, 11.875, 11.895, 11.974, 12.175, 12.199, 12.221, 12.360, 12.520, 12.856, 12.866). 2 ♂♂, 1 ♀, Tijucas do Sul, Vossoroca, 800 m, 19. xii. 1987, 28. xii. 1987, 11. iii. 1989, C. Mielke leg. (CGCM 11.414, 12.040, 12.680). 1 ♂, Tijucas do Sul, Vossoroca, 850 m, 22. iii. 2007, O. Mielke & Casagrande leg. (DZ). 1 ♂, Campo do Tenente, 31. i. 1968, Moure, Mielke & Luiz leg. (DZ). 1 ♂, Campo do Tenente, 24. ix. 1967, Moure & Mielke leg. (DZ). 1 ♂, Campo do Tenente, 3. xii. 1967, Moure & Mielke leg. (DZ). 2 ♂♂, Campo do Tenente, 28. ii. 1968, O. Mielke leg., ex coll. A. Cardoso (DZ). 1 ♀, Campo do Tenente, Estr. Campo do Tenente-Piên, km 6, 23. xi. 1997, C. Mielke leg. (CGCM 12.456). 1 ♀, Campo do Tenente, 850 m, 21. i. 1974, O. Mielke leg. (DZ). 1 ♂, Ponta Grossa, ii. 1958, ex coll. F. Justus jr. (DZ). 7 ♂♂, 3 ♀♀, Ponta Grossa, iii. 1948, v. 1948, viii. 1948, ix. 1948, iii. 1949, F. Justus jr. leg., ex coll. D'Almeida (DZ). 4 ♀♀, Ponta Grossa, iii. 1948, iv. 1948, ex coll. F. Justus jr. (DZ). 2 ♀♀, Palmas, i.–ii. 1931, V. Stawiarski leg., ex coll. Gagarin (DZ). 2 ♂♂, Guarapuava, Santa Clara, 650 m, 21. xi. 1986, O. Mielke & Casagrande leg. (DZ). 1 ♂, Rio Negro, 4. v. 1991, C. Mielke leg. (CGCM 12.376). — **Santa Catarina:** 2 ♂♂, 1 ♀, São Bento do Sul, 800 m (BC-Dec0396, BC-Dec0419, BC-Dec0421, CTD). 1 ♂, São Bento do Sul, 900 m (BC-Her0792, CDH). 2 ♂♂, São Bento do Sul, Rio Vermelho, 27.–28. xi. 1973, ex coll. A. Cardoso (DZ). 1 ♂, 1 ♀, São Bento do Sul, Rio Natal, 1. xii. 1986, O. + C. Mielke leg. (CGCM 11.593, 14.657). 1 ♀, São Bento do Sul, Rio Natal, 800 m, 1. ii. 2006 (BC-Dec1345; CTD). 2 ♀♀, Urubici, Serra do Panelão, 1250 m, 5. iii. 2000, C. Mielke leg. (CGCM 1.841, 1.953). 4 ♂♂, Urubici, Serra do Panelão, 1250 m, 26. ii. 2007, T. Decäens (BC-Dec1342, BC-Dec1343, BC-Dec1344, BC-Dec1502; CTD). 2 ♀♀, Urubici, Morro da Igreja, 1250 m, 18.–22. xii. 2000, Miers & C. Mielke leg. (CGCM 11.613, 12.536). 1 ♂, 1 ♀, Lages, 900 m, 14. ii. 1974, O. Mielke & Sakakibara leg. (DZ). 1 ♀, São Joaquim, 1400 m, 23. ii. 1973, O. Mielke leg. (DZ). 1 ♂, Rio das Antas, i. 1953, Camargo leg. (MZSP 01.955). 1 ♀, Bom Jardim da Serra, 1500 m, 1.–4. x. 1996, V. O. Becker leg. (CGCM 13.478). 2 ♂♂, Seara, Nova Teotônia, 450–700 m, ix. 1977, F. Plaumann leg. (DZ). 1 ♂, Corupá, 27. i. 1966, ex coll. Gagarin (DZ). — **Rio Grande do Sul:** 1 ♂, Cambará do Sul, Estância Cambará, 1040 m, 1.–4. i. 2006, C. Mielke leg. (CGCM 21.229). 1 ♂, Morro Heuter, Faz. Padre Eterno, 550 m, 4. iii. 2005, A. Moser leg. (BC-Her2471).

Immature stages: unknown. There is a dried immature (larva) in DZUP ex coll. F. Justus jr. with a label indicating "in bracatinga" (= *Mimosa scabrella* (Benth.), Mimosaceae).

Geographical distribution. *S. totoma* is known only from Southern Brazil (Fig. 10), from Paraná to Rio Grande do Sul. Two ♂♂ in Gagarin's collection (now DZUP) from Umuarama (Campos do Jordão) are probably mislabelled.

Diagnosis

Within the genus *Scolesa*, *S. jauffreti* sp. n. is similar to *S. totoma,* from which it is, however, easily distinguished by several characters that are constant among all examined specimens. These are listed in Table 1.

Table 1: Diagnostic characters for distinction of *Scolesa jauffreti* sp. n. from *S. totoma*.

♂	*S. jauffreti* sp. n.	*S. totoma*
Frons	beige to dark gray	beige
Discal spot on FW	absent or dark gray	absent or whitish
Thorax laterally	dark gray	beige
Abdomen dorsally	dark gray to dark brown	light to dark gray
FW postmedian line	dark gray and well marked	dark gray to almost absent
♀		
FW ground colour	brown suffused with dark gray	light brown
Sclerotized plate on ductus bursae	present	reduced or absent

In addition, *S. jauffreti* sp. n. is generally bigger (♂ FW length average 2.5 mm larger) than *S. totoma* (♂ FW length average corespondingly 2.5 mm smaller), and shows a pronounced forewing apex. No significant differences between the two species were found in the ♂ genitalia, which present a high degree of variability in both taxa. The lobe of the tegumen is variable in size and shape, ranging from barely distinct to well developed.

The neighbor joining tree derived from the DNA barcodes (Fig. 11) corroborates the description of *S. jauffreti* as a new species: the 4 specimens sampled have rigorously identical DNA sequences and are consistently separated from all available records of *S. totoma,* showing a clear congruence between molecular analyses and the results of our morphological comparisons. This pattern is further supported by available geographic distribution data. All known specimens of *S. jauffreti* sp. n. are restricted to the Mantiqueira mountains, further north and at higher elevations than the known distribution of *S. totoma*, with no overlap known to date. Although the new species is obviously very closely related to *S. totoma,* we consider that the general congruence between morphological, molecular and geographical evidence unequivocally supports the existence of two evolutionary significant units, one of which is here described as a new species.

Surprisingly, the analysis of DNA barcodes also revealed that *S. totoma* is further divided in two distinct genetic lineages (Fig. 11, lineages L1 and L2; Table 2).

Table 2: Minimum genetic distances (K2P, as percentages) between DNA barcodes of the newly described species and those for each of the two distinct lineages unveiled for *S. totoma*. The maximum intraspecific or intragroup variation is also given in the diagonal (number of records within brackets).

%	*S. jauffreti* sp. n.	*S. totoma* L1	*S. totoma* L2
S. jauffreti sp. n.	0 (4)	–	–
S. totoma L1	0.5	0.5 (3)	–
S. totoma L2	0.9	1.2	0.9 (7)

The minimum distance (K2P, as %) between DNA barcodes of the newly described species and those for each of the two distinct lineages unveiled for *S. totoma* are given in Table 2. The maximum intraspecific variation is also given in the diagonal (number of records within brackets).

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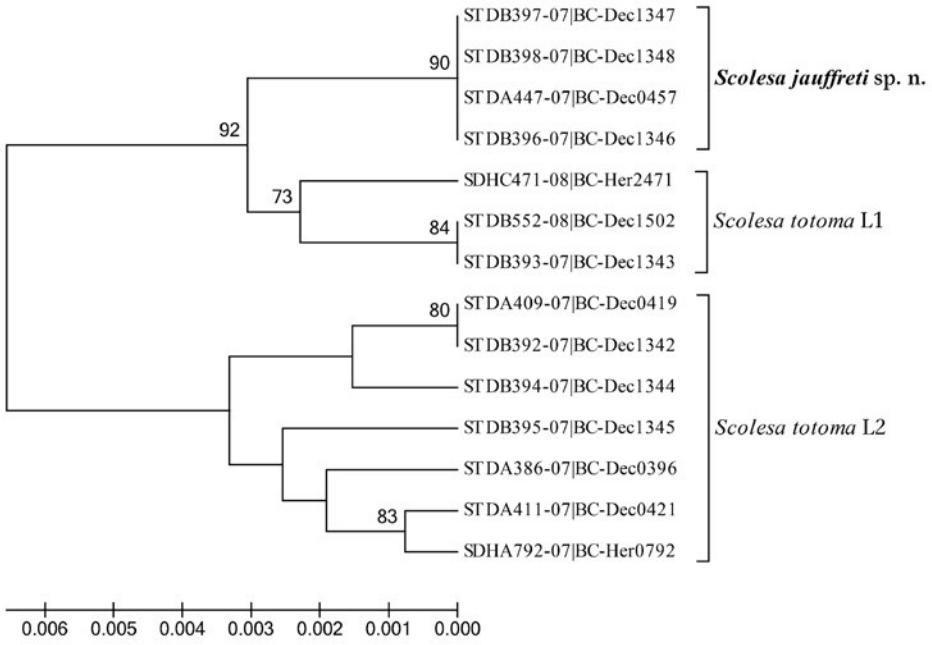

Fig. 11: Neighbor joining tree (K2P distances) built from DNA barcodes of specimens from *Scolesa totoma* and *Scolesa jauffreti* sp. n.; L1 and L2 designate the two reported lineages for *S. totoma,* the status of which remains unresolved. Bootstrap support values (after 1000 replications) higher than 70% are given above the respective branches.

Lineage L1 comprises specimens from Urubici (Santa Catarina state) and Morro Reuter (Rio Grande do Sul state), whereas L2 includes 5 specimens from São Bento do Sul (also Santa Catarina state) and 2 specimens from Urubici collected in the same site and during the same night as those within L1. These results suggest that *Scolesa totoma,* in its new understanding and excluding *S. jauffreti* sp. n., might still include two cryptic species. However, we could not find any morphological difference supporting this division and the coexistence of both lineages in Urubici remains puzzling. Further study and additional material will be needed to understand if there is a presence of two cryptic species or if the observed split in DNA barcodes has other causes such as, for instance, the maintenance of ancestral polymorphism in mitochondrial DNA, or the results of genetic "manipulation" by endosymbiotic bacteria (e.g., compare Smith et al. 2012).

Acknowledgements

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